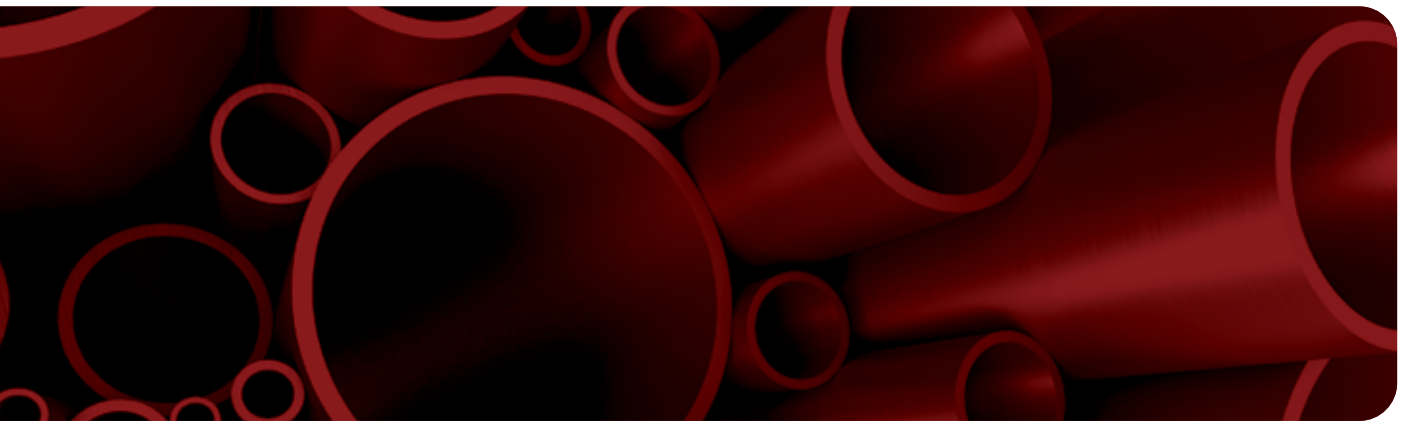

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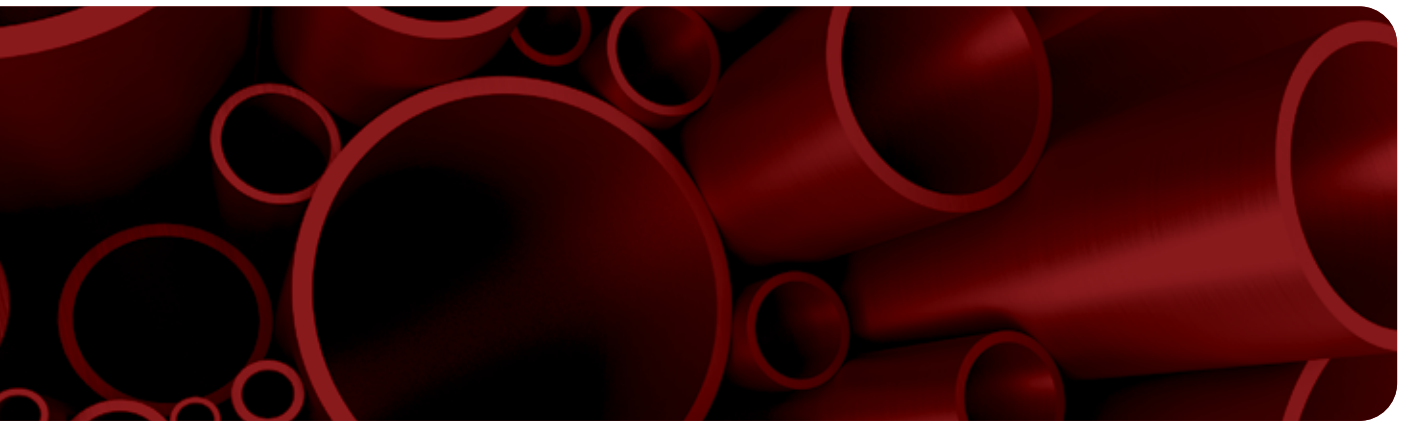

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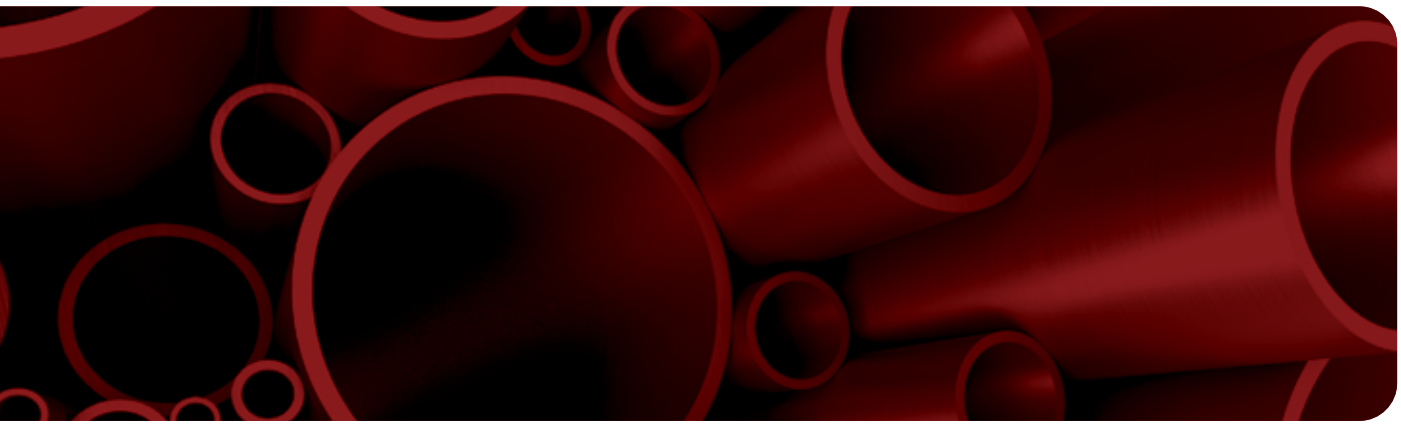

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I. INTRODUCTION

I.I Installation

The requirements for proper installation of Fiberglass piping systems installed on, or above, the surface of the ground. Designing a piping system to the latest engineering standards and techniques takes one half the way towards having a long lived, functional, piping system. The other half of the job is installation, or implementation of the design in the field environment. “The installation of fiberglass piping systems differs significantly from procedures for metallic systems”. For best results, approach installation with care and attention to detail.

Design considerations:

In preparing to install a fiberglass piping system, first review the design specifications and procedures. Information on type and spacing of supports, anchors, guides etc

Installation categories:

Two general categories encompass Aboveground installations. Some lines lay directly on the surface. Some are suspended, or supported, above the ground surface. The requirements for installation of both categories are essentially the same.

Deflection.

In general, the objective of any Aboveground installation is to provide supports, guides and anchors points in such a way that the deflection of unsupported span lengths are maintained within acceptable limits over the long-term.

Thermal expansion.

A good installation will compensate for the effects of thermal expansion. Temperature changes from environmental or operating conditions result in changes in length and end loadings on the pipe. The effect of thermal expansion often is greater with fiberglass piping than with metallic pipe systems. Prepare means of accommodating this charge in length and install it carefully to keep stresses, or strains, in the system below acceptable limits.

1. INTRODUCTION

1.2 Product Range

Tamdid Pipes Fiberglass Pipes are flexible, self-restrained, and corrosion resistant and are designed for aboveground and underground installations. It consists of a thermosetting chemical resistant resin and fiberglass reinforcements. Tamdid Pipes® manufactures its pipes using the filament winding process (Nominal Diameter 300mm - 4000mm) and helical winding process (Nominal Diameter 80mm - 600mm) according to AWWA M45.

Available standard pressure classes are PN1 (Gravity), PN6, PN10, PN16 and in different stiffness 2500N/m2, 5000N/m2 and 10000N/m2. Higher-pressure ratings are available upon request. The same pipes can be designed for use under vacuum conditions and also can be used for Underground applications.

Tamdid Pipes products can be used for a wide range of applications, such as cooling water, industrial waste water and effluents, fire water lines, seawater lines, acid cleaning and chlorination lines etc.,

1. INTRODUCTION

1.3 Applicable Codes / Standards

ASTM D 2996: Standards Specification for Filament-Wound "Fiberglass" (Glass-Fibre-Reinforced Thermosetting-Resin) Pipe.

ASTM D-3517: Standards Specification for "Fiberglass" (Glass-Fibre-Reinforced Thermosetting-Resin) Pressure Pipe.

ASTM D-3262: Standards Specification for "Fiberglass" (Glass-Fibre-Reinforced Thermosetting-Resin) Sewer Pipe.

ASTM D-3754: Standards Specification for "Fiberglass" (Glass-Fibre-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.

ASTM D4024: Standard Specification for Machine Made 'Fiberglass' (Glass-Fiber-Reinforced Thermosetting-Resin) Flanges. Applicable from 1/2 in. through 24 in. (13 mm through 600 mm) ANSI B16.5 #150 bolt circle flanges.

ASTM D4161: Standard Specification for 'Fiberglass' (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

API 15LR: Specification for Low Pressure Fiberglass Line Pipe. Applicable to 2 in. through 12 in. (50 mm through 300 mm) diameter pipe of epoxy or polyester resin for use at cyclic pressures to 1,000 psi (6,895 kPa).

AWWA C-950: AWWA Standard for Fiberglass Pressure pipe

AWWA M45: Fiberglass Pipe Design Manual

ASME B 31.3: Process Piping

BS 5480:British Standard Specification for Fiberglass (GRP) pipes, joints and fittings for use for water supply or sewerage.

BS 7159:British Standard Code of practice for Design and construction of Fiberglass (GRP) piping systems for individual plants or sites.

1.4 Types of Resin

The types of resins used in the pipe construction are as follows:-

GRP	Resin System	
	Liner	Structure
GRP	Isophtalic polyester	Isophtalic polyester
	Epoxy based Vinylester	Isophtalic polyester
GRV	Epoxy based Vinylester	Epoxy based Vinylester
GRE	Epoxy	Epoxy

2. SHIPPING, HANDLING & STORAGE

2.1 Shipping

Preparation for shipping should protect the pipe wall and joining ends from damage, and should be acceptable to the carrier, the manufacturer, and the purchaser.

Ship pipe on flatbed trucks supported on flat timbers or cradles (see figure 2-1). A minimum of two supports located at the pipe quarter points is typical. Timber supports should contact only the pipe wall (no joint surfaces). No bells, couplings, or any other joint surface should be permitted to contact the trailer, supports, or other pipe. The timber supports must be of sufficient width to avoid point loading. Chock the pipes to maintain stability and separation. To ensure that vibrations during transport will not cause abrasion damage, pipes should not be allowed to contact other pipes. Strap the pipe to the vehicle over the support points using pliable straps or rope without deforming the pipe. Bulges, flat areas, or other abrupt changes in pipe curvature are not permitted. Stack heights to the legal limits are typically acceptable.

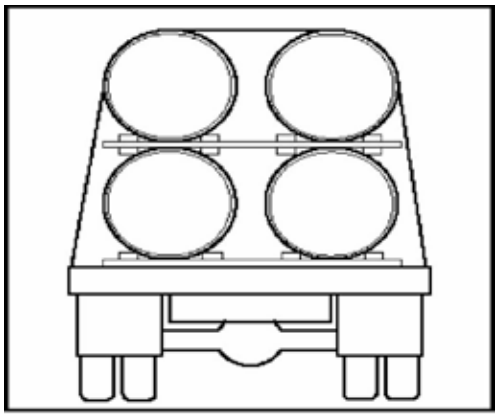


Figure 2-1 Pipe Shipment Truck

The purchaser should inspect the pipe upon receipt at the jobsite for loss or damage sustained in transit. Exterior inspection is usually sufficient; however, impact to the pipe exterior can cause interior cracking with little or no visible damage to the pipe exterior. Therefore, interior inspection at the location of exterior scrapes may be helpful when pipe size permits such an inspection. If the load has shifted or exhibits broken packaging, inspect each piece both internally and externally. The purchaser may also wish to re-inspect the pipe just prior to installation. If any imperfections or damage are found, contact Tamdid Pipes for recommendations concerning repair and replacement.

Note:Do not use pipe that appears damaged or defective. If in doubt, do not use. If it is necessary to transport pipes at the job site, it is best to use the original shipping dunnage.

2.2 Handling

Manufacturers' instructions regarding use of slings, spreader bars, or other handling devices should be followed. Lift pipe sections with wide fabric straps, belts, or other pliable materials. Do not allow the straps to deform the pipe. Avoid the use of steel cables, chains, or other materials that may damage the pipe surface. If cables, chains, or forklifts are used, sufficient care, padding, or protection must be used to prevent gouging, cutting, or otherwise damaging the pipe.

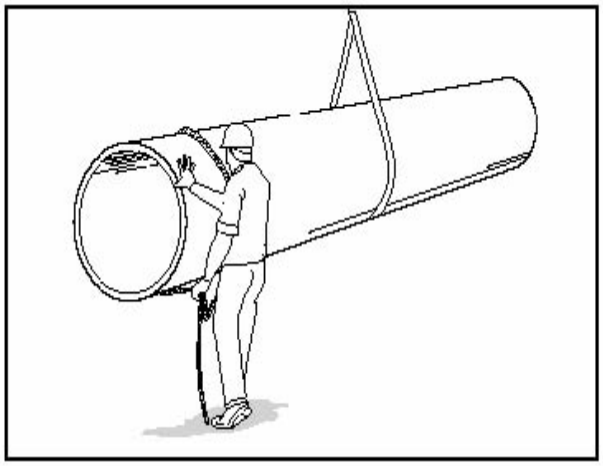


Figure 2-2 Single sling handling

Individual pipe sections can usually be lifted with a single sling (see figure 2-2) if properly balanced, but two slings as shown in figure 2-3 (located at the pipe quarter points) make the pipe easier to control. Do not lift pipe with hooks or rope inserted through the pipe ends. Because fiberglass pipe may be damaged by impact, do not drop or impact the pipe, especially the pipe ends. Pipe should never be thrown or dropped to the ground or set on sharp objects. Repair any damage prior to installation.

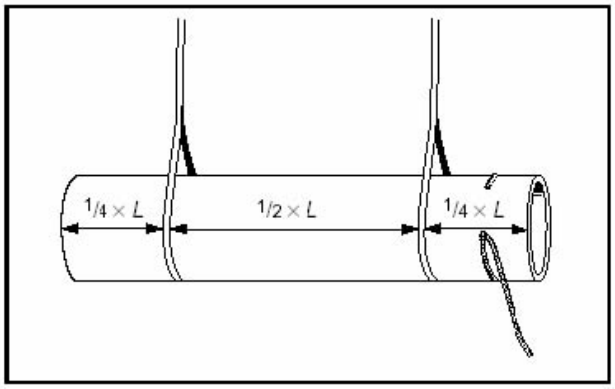
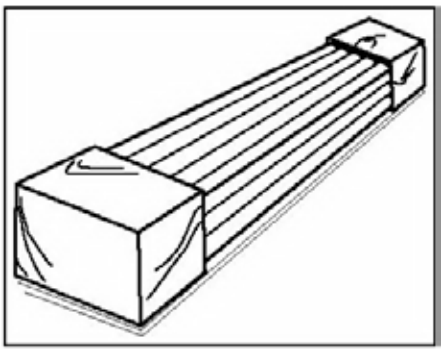


Figure 2-3 Double sling handling

2.2.1 Bundles.

Smaller pipe (24 in. [600 mm] diameter and less) are often unitized or bundled by Tamdid Pipes as shown in figure 2-4 & 2-5. Bundles and unitized loads typically must be handled with a pair of slings (never a single sling). Do not lift a non-unitized stack of pipe as a single unit. Non-unitized stacked pipe must be un-stacked and handled individually.



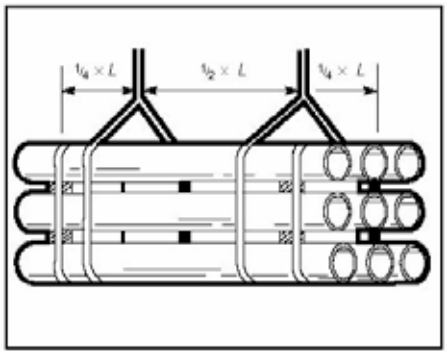
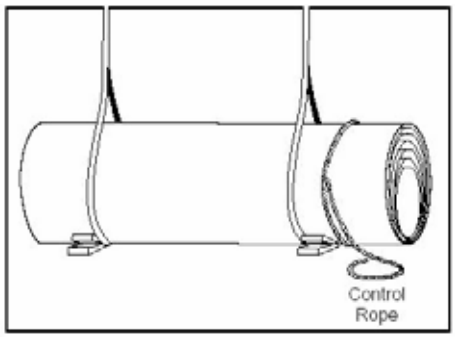


Figure 2-4 Unitized Small Diameter Bundle Figure 2-5 Unitized Load Handling

2.2.2 Nested Pipe.

Nesting smaller pipes inside larger pipes is acceptable. Ensure that the pipes are protected and secured properly to prevent relative motion or damage during shipment. Never lift nested pipe with a single strap; always use two or more straps as shown in figure 2-6.



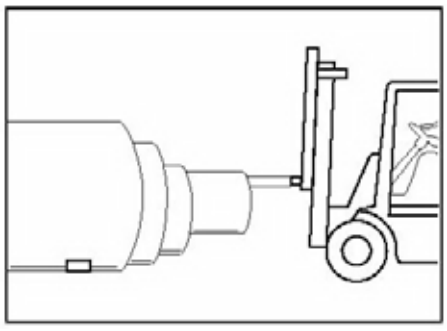


Figure 2-6 Handling Nested Pipes Figure 2-7 Nesting Pipe

Ensure that the straps have the capacity to hold the bundle weight. De-nesting is typically accomplished with three or four fixed cradles that match the outside diameter of the largest pipe in the bundles. De-nest beginning with the inside pipe (smallest diameter). The standard de-nesting procedure is to insert a padded forklift boom, lift slightly to suspend the pipe, and carefully remove it without touching the other pipe (see figure 2-7). When weight, length, and equipment limitations preclude this method, check with the Tamdid Pipes for specific recommendations for removing pipe from the bundle.

2.3 Storage

Pipe is generally stored on flat timbers to facilitate placement and removal of lifting slings (see figure 2-6). The support timbers should be of sufficient width to prevent point loads. Four-in. wide supports are recommended for large-diameter pipe. Pipe should be chocked to prevent rolling in high winds. When stacking, timber supports at the pipe quarter points are best. If available, use the original shipping dunnage for storage. The maximum stack height is typically 8 ft (2.4 m). Consult the manufacturer for maximum storage deflection. Bulges, flat areas, or other abrupt changes in pipe curvature are not permitted. Nylon or hemp rope tie-downs are best. Chain tie-downs must be well padded to prevent damage to the pipe wall.

When stored directly on the ground, the pipe weight should not be supported by the bell, coupling, or any other joint surface. The pipe should rest on plane ground and should not rest on rocks, boulders, or other hard debris that may cause a point load sufficient to gouge, crack, puncture, or otherwise damage the pipe wall. The pipe interior and all joining surfaces should be kept free of dirt and foreign matter.

2.3.1 Storing Gaskets and Lubricant

Rubber ring gaskets, if shipped separate from the couplings, should be stored in the shade in their original packaging and should not be exposed to sunlight except during the pipe joining. Also, the gaskets must be protected from exposure to greases and oils which are petroleum derivatives, and from solvents and other deleterious substances. Gasket lubricant should be carefully stored to prevent damage to the container. Partially used buckets should be resealed to prevent contamination of the lubricant.

Ultraviolet (UV) protection. Check with the Tamdid Pipes regarding the necessity of UV protection when stored outside.

Nested pipe. Store nested pipe only in the original transport packaging. Do not stack nested pipe unless approved by the Extra co. Transport pipe only in the original transport packaging.

Figure 2-8 Distributed Along the Trench

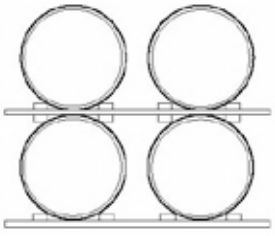


Figure 2-9 Pipes Stacking

2.3.2 Distribution along the trench

Avoid placing the pipes where they can be damaged by traffic or blasting operation as shown in figure 2-8. Also avoid laying the pipes on sharp rocks or objects that may damage and affect their function. Store pipes if possible on soft level ground (e.g. sand), timber bearers or sand bags.

Caution: *Pipes must not be stored on rocks.*

2.3.3 Storing in stock piles

Care must be taken that the storage surface has the same level, firm as possible and clear of rocks or solid objects that might damage the pipes as shown in figure 2-9. Store the pipes in separate stock-piles according to their class and nominal diameter. Pipes are to be placed on wooden timber at a maximum spacing of 6 meters. Any extraneous materials are to be removed from the area. Stockpiles should not exceed the heights shown in the table below. This height is limited for safety purpose and to avoid excessive loads on the pipe during storage.

DN	80-400	450-600	700-800	900-1400	> 1500
Layers in stock pile	5	4	3	2	1
H max. (Storing / Stocking height)	< 2m	< 2.4m	< 2.4m	< 2.8m	OD of Pipe

Wooden wedges, used in order to prevent the pipe stack from sliding, should be placed on both sides of the stack, on the timber bearer, as shown in figure 2-8 & 2-9.

3. JOINTS

3.1 Introduction.

Several types of joining systems are available for use with fiberglass pressure pipe. Many of the systems permit joint angular deflection. Some joining systems may be designed to resist longitudinal thrust forces. Fittings and specials are available in a range of styles and configurations and are fabricated by a number of different manufacturing methods.

There are many joining systems, and variations of those systems that meet International Standard requirements and that are available on fiberglass piping products. Many systems meet specific project needs.

3.2 Fiberglass Pipe Joining Systems Classification

There are two general joint classifications
1)unrestrained &
2) restrained.

3.2.1 Unrestrained Pipe Joints

These joints can withstand internal pressure but do not resist longitudinal forces. They rely on elastomeric gaskets to provide the seal. Typically, these joints can be disassembled without damage.

Fiberglass Couplings or Bell and Spigot Joints.
These joints use an elastomeric seal located in a groove on the spigot or in the bell as the sole means to provide fluid tightness.

Mechanical Coupling Joint.

These joints use mechanically energized elastomeric gasket seals to join two pieces of pipe.
The mechanical coupling technique applies to plain end pipe.

3. JOINTS

3.2.2 Restrained Pipe Joints

The restrained pipe joints can withstand internal pressure and resist longitudinal forces.

Joints that may later be disassembled without damage include:

- Coupling, or bell and spigot with a restraining device
- Flange
- Mechanical

Joints that cannot be disassembled without damage or cutting apart include:

- Butt and wrap
- Wrapped bell and spigot
- Bonded bell and spigot

3. JOINTS

3.3 Joining Systems Description

In this section, many of the joining systems available with fiberglass pressure pipe are described; however, the details of every type of joining system available are not included. Versatility of manufacture permits differences in configuration and geometry while meeting performance requirements. Users should contact the Extra co. to obtain specific details on joints and joint performance.

3.3.1 Adhesive-Bonded Joints

Three types of adhesive-bonded joints are available:

- Tapered bell and a tapered spigot
- Straight bell and straight spigot joint
- Tapered bell and a straight spigot

Adhesive-bonded joints are generally available for pipe up through 16 in. (400 mm) diameter.

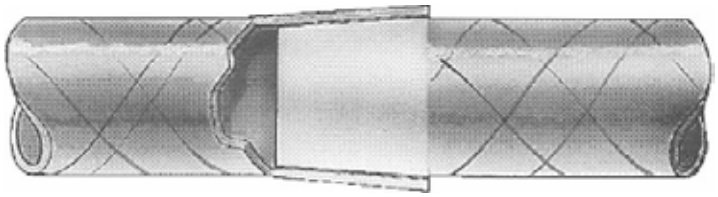


Figure 3-1 Tapered Bell & Spigot Adhesive Joint

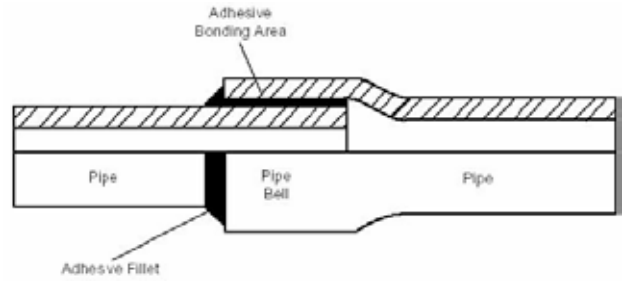


Figure 3-2 Straight Bell & Spigot Adhesive Joint

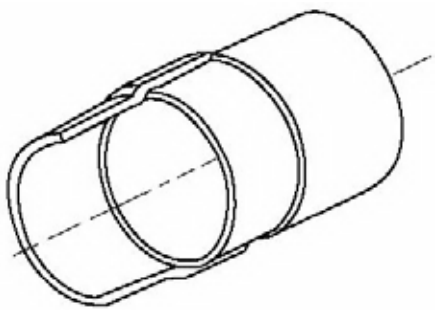


Figure 3-3 Tapered Bell & Straight Spigot Adhesive Joint

3. JOINTS

3.3.1.1 Procedure for Assembly of Adhesive-Bonded Joint

I. Sanding & Cleaning:

The surface of the socket end should be sanded within one hour of assembly. Use a clean cloth to remove all dirt. If the surface has been in contact with oil or grease, remove this with a clean cloth soaked in acetone, M.E.K. (methyl ethyl ketone) or M.I.B.K (methyl isobutyl ketone). Do not use paint-thinners, petrol or alcohol.

Sanding should be done by using an electric drilling machine (6 mm) with flapper sander or sanding bobbin. Sand the spigot end using a coarse emery cloth. Use Grade P40 to P60 emery cloth.

After sanding surfaces should look clean and bright. Do not forget to sand the stop shoulder in the socket end.

After sanding all areas, the inner surface of the socked end and the outer surface of the spigot end should be thoroughly cleaned with a dry clean cloth. If the topcoat did not disappear completely during the machining operation, it should be removed manually during the sanding operation.

If bonding has not taken place within one hour after sanding, re-sanding and cleaning of all surfaces must be done.

If the surfaces are wet before bonding, warm with an electric heating blanket until they are dry, then re-sand and clean. Do not touch the prepared surfaces with bare hands or dirty gloves which might leave an oily film.

II. Adhesive:

Concresive adhesive is used for bonding the socket and spigot. Kit sizes of 3kg are available. 3kg is sufficient to cover 1.1m2 at 1.5mm thick. Adhesive has to be stored at temperatures below 300C. Be aware of the pot life after mixing, for pot life and other details refer Adhesive material data sheet supplied with the kit.

III. Applying the adhesive:

Apply a thin, uniform layer of adhesive of approximately 0.5-0.8 mm thickness to the inner surface of the socket with the supplied stick or a rubber spatula or trowel. Too much adhesive in the socket will result in a flow resistance. Apply a uniform and somewhat thicker layer of approximately 0.8-1 mm thickness to the other surface of the spigot.

3. JOINTS

IV. Assembly of the joint:

Insert the spigot into the socket end and push it home, rotating the pipe slowly one quarter of a turn if possible. Be sure the spigot butts against the pipe stop and when necessary tap on a wooden block, placed over the pipe end. Never hit with a metal hammer directly on pipes and fittings.

V. Workman shop:

Remove the excessive adhesive from the surface with the spatula (and if possible from the inside of the joint).

Attention: *Do not disturb the curing of the adhesive by moving or vibrating the joint.*

3. JOINTS

3.3.2 Butt & Wrap Lamination Joints

Before starting a butt and wrap joint, all safety precautions will need to be checked. Ensure that all necessary tools and materials are available.

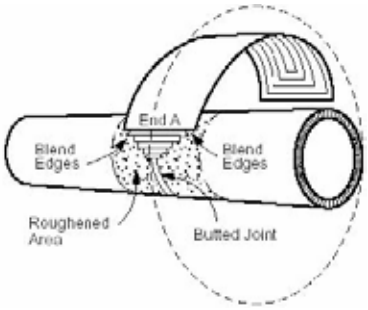


Figure 3-4 Butt & Wrap Lamination joint construction

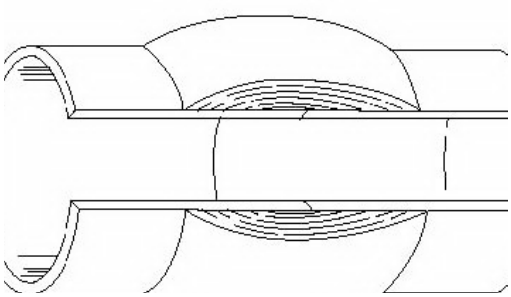


Figure 3-5 Overlay joint

3.3.2.1. Tools for Butt & Wrap Lamination Joints

For butt and wrap joints the following tools are required:

a. Measuring tape + pipe fitter's wrap-a-round + marker pen.
b. Cleaning-rags.
c. Angle grinder with diagrit or carborundum cutting disc (grain 24), a handsaw 24 teeth/inch, jig saw with a 14 teeth/inch blade.
d. Angle grinder + sanding disc + flexible support disc.
e. Resin, hardener and glass reinforcement + a pair of scissors.
f. Gloves, brushes, rollers, dust masks in quantities as mentioned in the fit and laminating sets, a pair of safety glasses.
g. Shelter (depending on the weather circumstances).
h. Insulation blanket.
i. Hot air gun (paint stripper gun), digital temperature gauge, gas burner, field oven, heating blanket, variable energy control (rheostat).
j. Pipe clamp, bench and rubber strips (under chain clamp).
k. Generator.

For the butt and wrap joint procedures see instructions enclosed with the lamination sets. These instructions include; mixing, the fit procedure, lamination and curing.

3. JOINTS

3.3.2.2 Mixing

The full contents of the hardener must be added to the container with the resin and carefully mixed. The resin and hardener contain the right mixing ratio.

3.3.2.3 Fit layer

The functions of the fit layer are, firstly, to ensure proper positioning and, secondly, to create a seal. The fit layer, with its lower viscosity, will not drain from the V-shaped seam.

3.3.2.4 Lamination

Grind the surface (ensure the top coating is removed) and remove the dust using a clean dry cloth or brush to ensure a good adhesion between fit layer and laminate. The work must continue within the hour, otherwise the grinding and cleaning operation will have to be repeated. Ensure that tolerances are not exceeded. The laminate should be built as per the standard lamination procedure with alternate layer of Chopped strand mat & Woven Roving. Remove excess resin using a rubber spatula.

3.3.2.5 Curing

The lamination will harden at ambient temperatures. This can be speeded up by applying heat using for example, an infra red device or hot air gun. The hardening process needs to be done gradually.

After the lamination is no longer sticky, curing can be continued with the aid of heating blankets, hot air guns or ovens. Heating up to the curing temperature should also be performed gradually. The curing time only starts when the laminate has reached the correct curing temperature.

The joint is ready and can be tested when the laminate is fully cured and has cooled down.

3.3.3 Flanged joint

Fiberglass flanges are flat faced. These flanges must always be accurately aligned and not subject to any stress. On the Fiberglass side of the flanged joint the bolts/stud and nuts must have washers to avoid exceeding the permitted surface pressure.

Bolts in flanges must be placed on either side of the centerline unless otherwise specified. The flange must be connected perpendicular to the axis of the pipe.

Tightening the bolts must not pull pipes together. If a Fiberglass is connected to a metal pipe, this metal pipe must be anchored to prevent any movement or loads being transmitted to the Glass Reinforced Pipe line.

3. JOINTS

Before assembling the Flanged Joints, all safety precautions will need to be checked. Ensure that all necessary tools and materials are available.

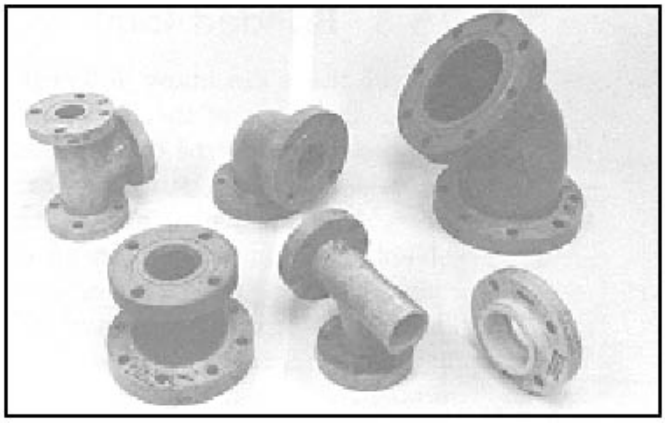


Figure 3-6 Flanged Pipe Fittings

There are four different types:
1.Fiberglass to steel connected with bolt and nut
2.Fiberglass to Fiberglass connected with bolt and nut
3.Fiberglass to steel connected with stud bolt and two nuts
4.Fiberglass to Fiberglass connected with stud bolt and two nuts

3.3.3.1 Tools for Flange Joints

Tools necessary for assembly of flanges:
a.Ring spanner with required bolt head size
b.Torque wrench with required socket size

3.3.3.2 Procedure for Assembly of Flanges

When assembling, the bolts should be tightened first by hand and then with torque wrench up to the recommended torque with an increment of 7N.m. Tightening of the bolts of flange connections must be done diagonally according to the sequence as shown in figure. Do not exceed the torque given in recommended bolt torques. Recheck the torque on each bolt in the same sequence. If leakage occurs during pressure tests, the bolts can be tightened up to the max values. Any sign of flange damage (crumbling, flaking, cracking, or other breaking) shall constitute failure.

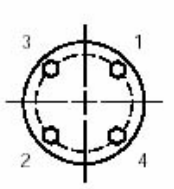
To prevent damage of the flanges when tightening, spacers may be placed between the Fiberglass flanges.

Caution: *Excess torque can prevent sealing and can damage flanges.*

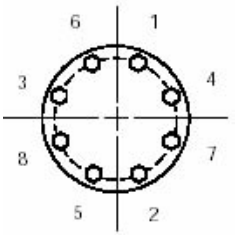
3.3.3.3 Gaskets and Torque value & Sequence

Use full-face gaskets of an elastomeric suitable for the service pressure and temperature and fluids in the system. Gaskets should be 1.8 inch thick (3 mm) thick with a Shore durometer hardness between 55 and 65.

For Fiberglass flanges several gaskets may be used, depending on the diameter, system pressure or specific requirements of the client. To prevent excessive bending on Fiberglass flanges the max bolt torques are specified. In order to determine the right torque value and to protect flange back facing it is necessary to lubricate washers under both nuts and bolt heads

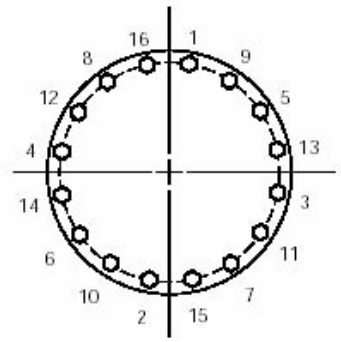


No. Of Holes = 4

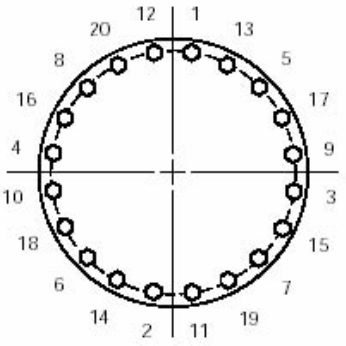


No. Of Holes = 8

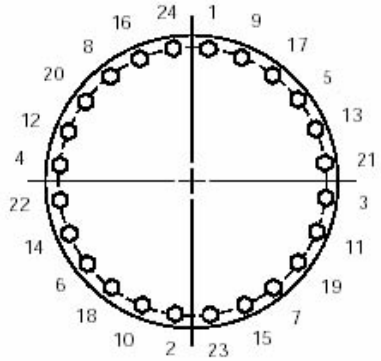
No. Of Holes = 12



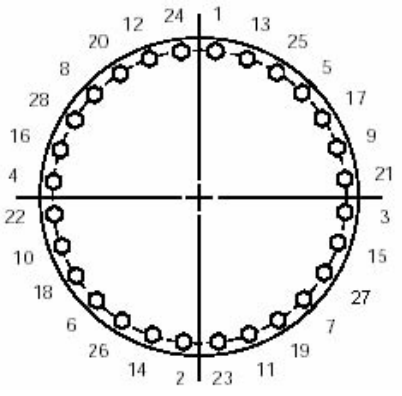
No. Of Holes = 16



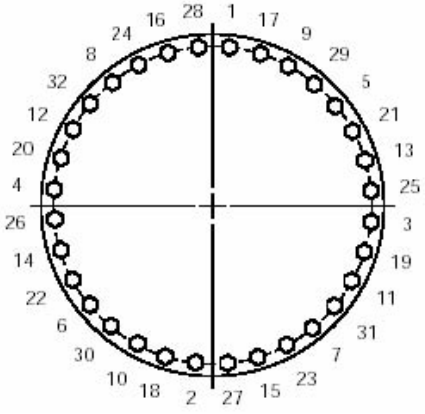
No. Of Holes = 20



No. Of Holes = 24



No. Of Holes = 28



No. Of Holes = 32

Figure 3-7 Tightening Sequence

Recommended Bolt Torques

ID (mm)	Bolt Torque BS 4504 Table 10 (PN10)	Max torque (Nm) DIN 1882 DIN 2501 ND 10	Max torque (Nm) DIN 2502 ND 16 ASA 150	Max torque (Nm) DIN 2501 ND 25 ASA 300	Torque increment (Nm)
5	25	70	70	100	7
40	25	100	100	150	7
50	25	100	100	150	7
80	25	100	100	150	7
100	20	100	100	250	7
150	35	150	150	250	14
200	45	150	150	300	14
250	55	150	300	500	14
300	75	150	300	550	14

ID (mm)	Bolt Torque BS 4504 Table 10 (PN10)	Max torque (Nm)	Torque increment (Nm)
350-450	95-115	400	14
500-600	115-170	500	27
700-1400	170-230	700	34

3.3.3.4 Assembly and disassembly of flanged equipment

Ensure that the joint is fully extended and the stop of both, the socket and the spigot end are in contact with the locking strip. Assembling flanged parts (equipment, valves, adjusting pieces, orifice flanges etc.) one must bear in mind that these parts could also be dismantled.

To provide space for disassembly in any installation there must be a rubber seal joint at one side. This allows some displacement in the axial direction using the clearance in the socket.

The lengths can be calculated with the following formula:
1.L = T + t + p + r + m + 5 (case 1)
2.L = 2T + p + 2r + m + 5 (case 2)
3.L = T + t + p + 2r + 2m + 5 (case 3)
4.L = 2T + p + 2r + 2m + 5 (case 4)

Explanation of symbols:
T = thickness of Fiberglass flange, for various pressure ratings
t = thickness of the steel flange
p = thickness of the gasket
r = thickness of the washer
m = height of the nut
5 = allowance in addition to the tolerance of the flange thickness
(Dia. 25 to 300: 0, + 3 mm)
(Dia. 350 to 1200: 0, + 5 mm)

3.3.3.5 Trouble shooting

If assembled joint leaks,

1. Loosen and remove all bolts, nuts, washers and gaskets.
2. Check for alignment of assembly. Rebuild to correct alignment as required.
3. Check the gasket for damage. If damaged, discard and replace with new, undamaged gasket.
4. If leaks occur as a result of deficiencies in non-fiberglass components of the piping system, consult the manufacturer of the defective components for recommended corrective procedures.
5. Clean and lubricate old threads and washers before rejoining. Repeat the joining procedure outlined above.
6. After corrective action has been taken, retest the joint to see if a seal has been made.

3.3.4 Rubber seal joints (RSJ)

Before assembling the Rubber Seal Joints, all safety precautions will need to be checked.
Ensure that all necessary tools and materials are available.

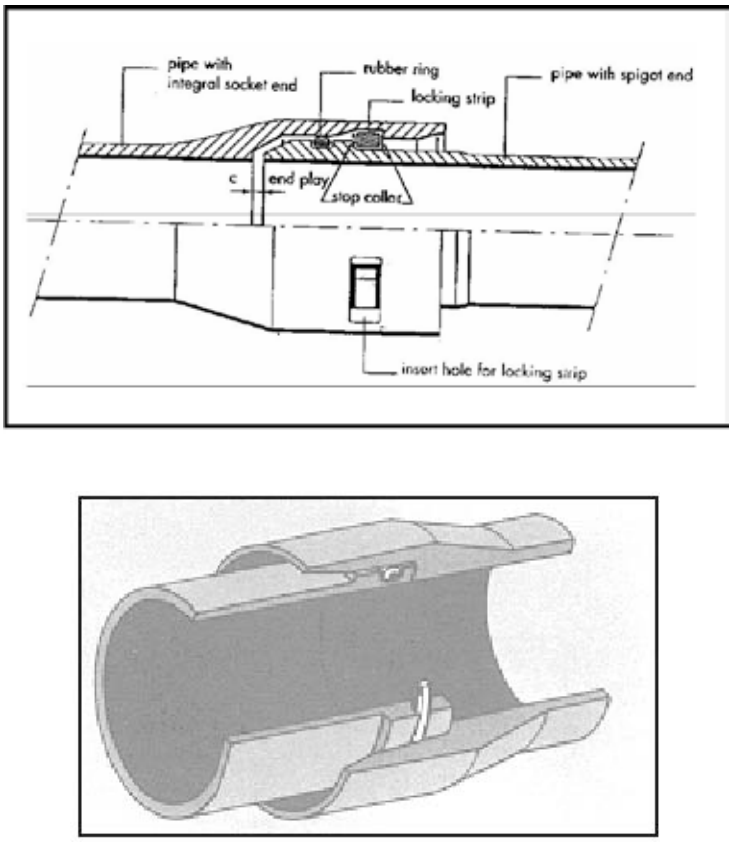


Figure 3-8 Rubber Seal Joint

3. JOINTS

3.3.4. I Tools for rubber seal joints.

For assembly of rubber seal joints the following is needed:

a. Lubricant for O-ring and locking strip
b. A rod or stick
c. 2 pipe clamps
d. Chain tackles (2) up to ID 500 mm pulling force 750 kg. ID > 500 mm pulling force 1500 kg.
e. Plastic or wooden mallet to drive the locking strip into the rubber seal lock joint
f. Cleaning-rags

3.3.4.2 Procedure for Assemble of Rubber Seal Joint:

To assemble a rubber ring joint use the following procedure:

- Clean the spigot and socket end thoroughly with a clean cloth before jointing. Do not use material like dusters in order to avoid fibers from sticking to the surface of the seal.
- Check both pipe ends for damage.
- Mark the depth of entry on the spigot end. The measurement of the mark on the spigot end.
- Position the rubber ring into the groove of the spigot end.
- Use a round tool like a screwdriver underneath the rubber ring and work it around a few times in order to distribute the tension.
- Apply lubricant to the rubber ring and the entire inner surface of the socket end. Avoid any lubricant under the rubber ring in order to prevent it from slipping out of the groove. Do not try to assembly the joint without the use of any lubricant. The standard lubricant can cause filters to block. Tamdid Pipes can supply lubricants, which are soluble in water. Soft soap can be used as an alternative for the lubricant.
- Fit the rubber lined clamps on both sides of the joint.
- Ensure that the spigot end is positioned right in front of the socket end and that both sections are fully aligned.
- Attach the chain tackles to the clamps on both sides of the parts to be connected and ease the spigot slowly and gradually into the socket until the mark is in line with the front of the socket end.
- If in doubt, check with a thin feeler gauge around the circumference, to confirm that the rubber ring is in the right position in the groove.
- Diameters up to 300 mm can be installed without the use of tackles. The force necessary to make the joint can be done by using a wooden beam as a lever at the end of the pipe. Another method which sometimes works is by using the excavator for pushing the pipe home. This method has the disadvantage that overall control and the feel of the correct movement of the spigot into the socket is lost.
- Do not try to join two pipes at an angle, since it is probable that the rubber ring may slip out of the groove. However, if necessary, only after assembly of the joint a permitted angle may be used. Do not use the maximum permitted angle where you anticipate soil settlement.

3. JOINTS

3.3.5 Rubber Seal Lock Joint (RSLJ)

3.3.5.1 Procedure for Assemble of Rubber Seal Lock Joint:

- Position the hole so the locking strip can be inserted easily.
- Follow the assembly instructions for the rubber seal joints (RSJ).
- Attach the chain tackles to the clamps on both sides of the pipe and ease the spigot end slowly and gradually into the socket end until the rear stop of the spigot end is past the hole of the locking strip.
- Apply some lubricant on the first section of the locking strip.
- Insert the locking strip in such a way that the beveled end rests against the inside of the socket.
- Using a plastic hammer or a piece of wood, tap the locking strip home until it rests against the first part of the strip.
- The end of the locking strip sticks out by approx. 100 mm. This allows disassembly of the newly assembled joint.
- Ensure that the stop of both the socket end and the spigot end are in contact with the locking strip and that the fully extended system is kept in this position.

Note:At low temperatures a plastic locking strip may become less flexible.
In that case it is advisable to warm the locking strip up to about 20°C.

For RSJ systems an additional 'end play' of 30 mm is allowed for diameters up to 300 mm and 50 mm for diameters 350 mm up to 1200 mm. This 'end play' allows for contraction as a result of pressure, temperature changes and soil settlements and therefore should not be used in the installation.

3.3.5.2 Rubber Ring Material

The commonly used rubber ring is made of EPDM. Other types of rubber can be supplied depending on the medium and/or the temperature.

The different types of rubber can be recognized by the following codes:

S Styrene Butadiene Rubber SBR
N Nitrile Butadiene Rubber NBR
E Ethene Propene Terpolymer EPDM
F Fluor Elastomer FKM
H Hydrogenated Nitrile Butadiene Rubber H-NBR

3.3.5.3 Disassembly of rubber seal joints

In principal it is possible to take rubber seal joints apart within a short period after installation.

In practice the joint will be cut out due to the lack of space to pull the spigot out of the socket, unless it is the last installed joint.

A rubber seal joint can be taken apart without any difficulty.

The dismantling procedure for a rubber seal lock joint is as follows:

- Push the pipe back into position to free up the locking strip if possible.
- Grip the locking strip with a pair of pliers or a plate clamp.
- Tap the pliers or use a crane to pull the plate clamp to remove the locking strip. (If the locking strip jams, turn the pipe a little while pulling the strip).
- Pull the spigot end out of the socket until the rubber ring is positioned at the insertion hole of the locking strip.
- Pull the rubber ring through this hole, cut the rubber ring and remove the ring completely through the hole.
- Now the joint can be released completely.

3.3.6 Mechanically coupled joints.

Mechanically coupled joints typically seal on the OD of plain end pipes through the use of gaskets that are loaded mechanically (compressed) to affect the seal. There is no ability to accommodate longitudinal forces in this design.

4. ACCESSORIES

4.1 Supports

Above ground systems should be properly supported to control pipe movements and accommodate the various stress from operations. The location and function of the supports along the pipeline should be identified by an experienced engineer, who will base these recommendations on a stress and/or surge analysis of the system. All the relevant information should be made available to enable the engineer to consider all the factors related to the loads built up in the system

To prevent excessive pipe deflection due to the pipe and fluid weight, support horizontal pipe (see Figure 4.1) at intervals determined by one of the following methods.

Type I. Pipe analyzed as simply supported single spans (two supports per span length) with the run attached to a fitting at one end, or any other section of less than three span lengths. Beam analysis for other types of spans, such as a section adjacent to an anchor, is sometimes used to obtain a more accurate span length.

Type II. Pipe analyzed as a continuous beam—three spans—all loaded.

Type III. Pipe analyzed as a continuous beam—four spans—all spans loaded.

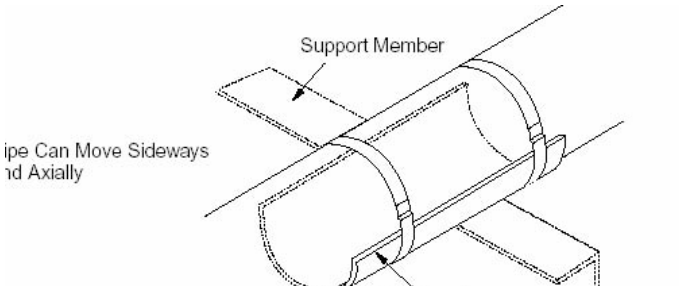


Figure 4-1 Typical support

4.1.1 Vertical Support

Support vertical pipe runs as shown in figure 4-2. The preferred method is to design for "pipe in compression." If the "pipe in tension" method cannot be avoided, take care to limit the tensile loadings below the recommended maximum tensile rating of the pipe. Install guide collars using the same spacing intervals used for horizontal lines.

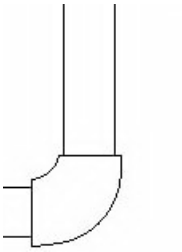


Figure 4-2 Vertical support

4. ACCESSORIES

4.2 Guides

The guiding mechanism must be loose to allow free axial movement of the pipe. However, the guides must be attached rigidly to the supporting structure so that the pipe moves only in the axial direction (see figure 4-3).

All guides act as supports and must meet the minimum requirements for supports.

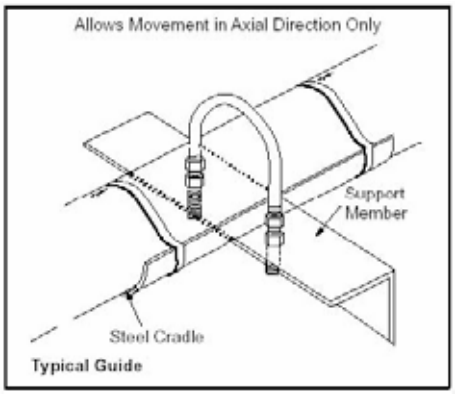


Figure 4-3 Guide support

4.3 Anchors

An anchor must restrain the movement of the pipe against all applied forces. Pipe anchors divide a pipe system into sections. They attach to structural material capable of withstanding the applied forces. In some cases, pumps, tanks, and other similar equipment function as anchors. However, most installations require additional anchors where pipe sizes change and fiberglass pipe joins another material or a product from another manufacturer. Additional anchors usually occur at valve locations, changes in direction of piping runs, and at major branch connections. Saddles and laterals are particularly sensitive to bending stresses. To minimize stresses on saddles and laterals, anchor the pipe on either side of the saddle or anchor the side run.

Figure 4-4 shows a typical anchor. Operating experience with piping systems indicates that it is a good practice to anchor long, straight runs of aboveground piping at approximately 300 ft (91 m) intervals. These anchors prevent pipe movement due to vibration or water hammer.

One anchoring method features a clamp placed between anchor sleeves or a set of anchor sleeves and a fitting. The sleeves bonded on the pipe prevent movement in either direction.

Sleeve thickness must equal or exceed the clamp thickness. To achieve this, it often is necessary to bond two sleeves on each side of the clamp. Anchor sleeves are usually one pipe diameter in length and cover 180° of circumference. Anchors act as supports and guides and must meet minimum requirements for supports.

4. ACCESSORIES

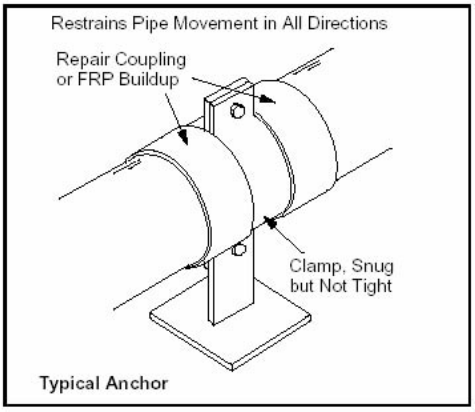


Figure 4-4 Anchor support

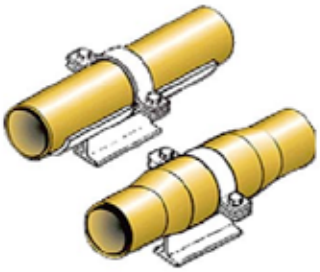


Figure 4-5 Additional Laminates & Bonded Collars on Both Sides Of The Clip

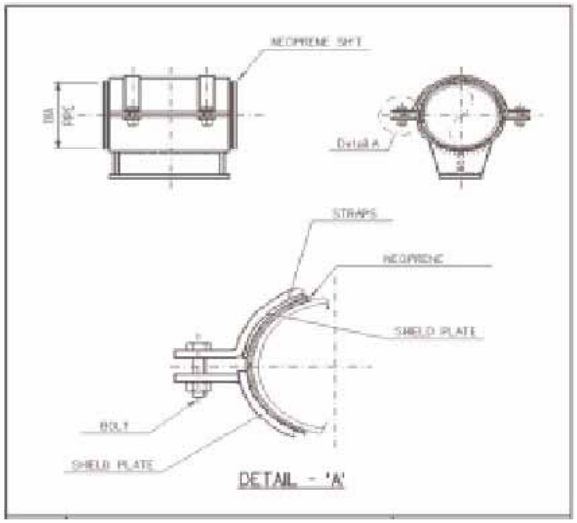


Figure 4-6 Sample Pipe and Flange Supports

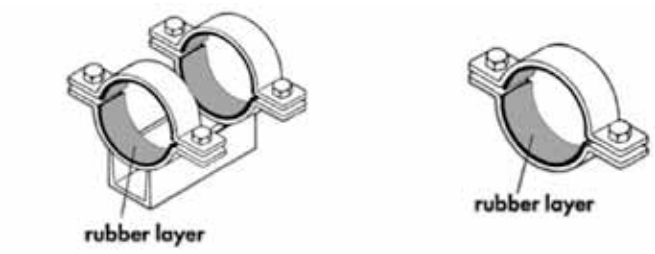


Figure 4-7 Pipe Clip

4. ACCESSORIES

4.4 Valves

To avoid the pipes being over-stressed by bending, gate valves, butterfly valves or other heavy accessories must be supported separately. This can be done by direct support of the valve or indirectly by means of the flange bolts (See Figure 4-8).

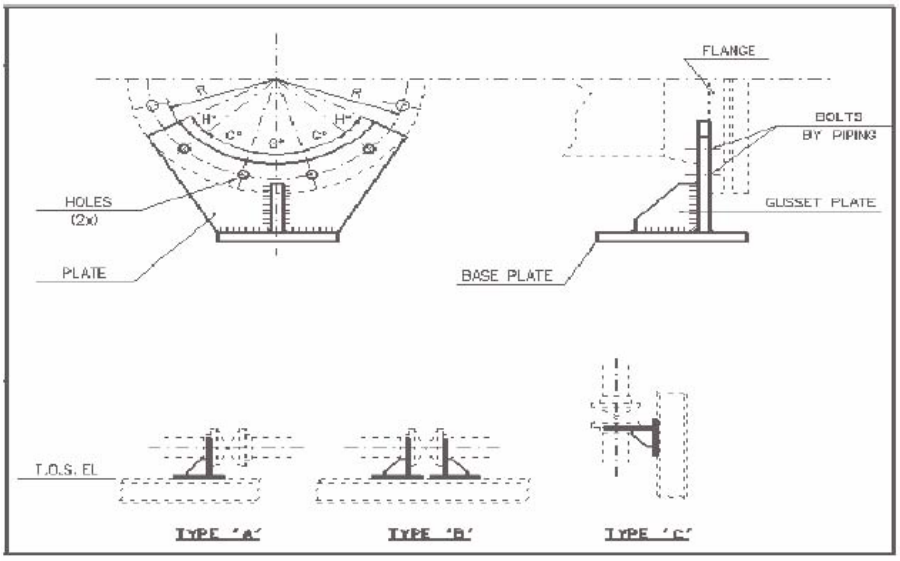


Figure 4-8 Typical Valve Support

If Fiberglass flange is connected to a steel flange, the support shall be located at the side of the steel flange. Hand operated butterfly valves can be supported or mounted (See figure 4.9).

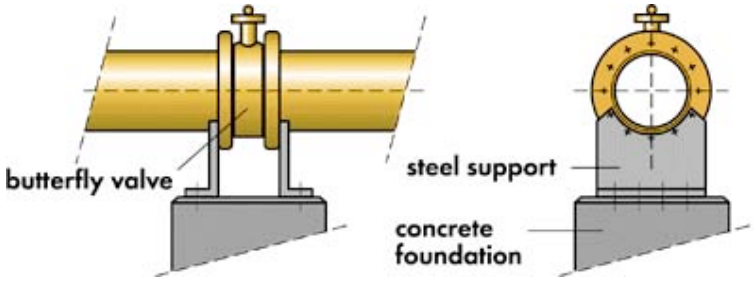


Figure 4-9 Typical Butterfly Valve Support

Note: For valves installed on branch saddles, care shall be taken to install gussets plates to reinforce the branch. A valve support may also be required for heavy flanges.

4. ACCESSORIES

4.5 Bellows

Low amplitude vibrations are easily absorbed by fiber glass pipes due to the low E-modulus of material.

To eliminate high amplitude vibrations caused by pumps and to eliminate soil settlements or expansion of tanks connected to the fiberglass pipes, bellows may be employed. Bellows may also be employed where straight piece of pipe (see Figure 4-10) is used and no expansion loops can be applied, or for branches if main pipeline may expand and move (and such movement may affect the rigid joint between the branch and main line).

In many cases it is possible to connect a bellow directly to the vibrating item by means of flanged joints. Immediately next to this bellow the pipe section must be supported separately to absorb the pipe loads.

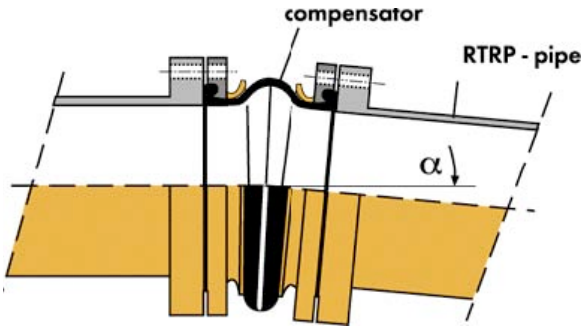


Figure 4-10 Bellows Connected to Pipe

Bellows may also be employed to facilitate the removal of the pipe sections, valves, orifice flanges or gaskets for repair purposes. The flexibility of the bellow provides a play of 10mm up to 20mm, which allows an easy and quick dismantling and installation of flanged components.

4. ACCESSORIES

4.6 Connection to other materials

The most appropriate joint to interconnect piping components of different materials is the flanged joint. Also, the mechanical coupler can be used as an alternative.

Flange drillings are made according to the International Standards. The flanged connections can be used with standard Tamdid Pipes products.

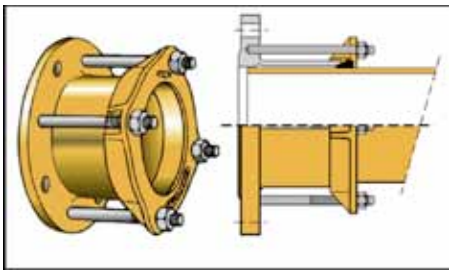


Figure 4-11

Note: When a flanged Tamdid Pipes pipe section is connected to a metal pipe section, this metal part must be anchored so that no contraction or expansion forces will be transmitted to the pipe section.

5. UV RESISTANCE

The Glass Reinforce Plastic Pipes contain UV inhibitor for Aboveground Pipes. This layer offers sufficient protection against UV radiation. After a long exposure to the ambient atmosphere the topcoat layer might show some chalking. This chalky has a superficial effect and doesn't affect the integrity of the product. If the appearance of pipes is important a protective polyurethane paint coating can easily be applied.

5.1 Procedure for Painting:

•Clean the outside surface with thinner
•Apply one layer of primer color red brown or beige, re-coatable after 8 hours at 20oC. (Approx. Coverage 5.5 m2/l)
•Apply one layer of topcoat polyurethane HB, color white, re-coatable after 8 hours at 208c, (Approx. coverage 4.8 m2/l)

Note: If painting of a recently installed pipe is required, the surface of the pipe shall be roughened in order to get a proper adhesion.

6. PIPE CONNECTIONS THROUGH (CONCRETE) WALLS.

Several alternatives are available for Glass Reinforced Plastic pipe connections through (concrete) walls.

a. A GRP pipe piece provided with a puddle flange
b. A Link-Seal
c. Casting and sand coated RTRP pipe into the concrete wall
d. A rolling ring
e. A special shaped sealing
f. No connection of the pipe to the (concrete) wall.

6.1 Fiberglass pipe piece provided with a puddle flange

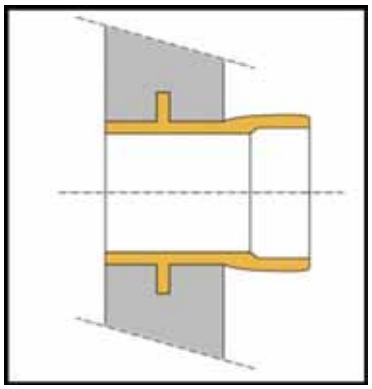
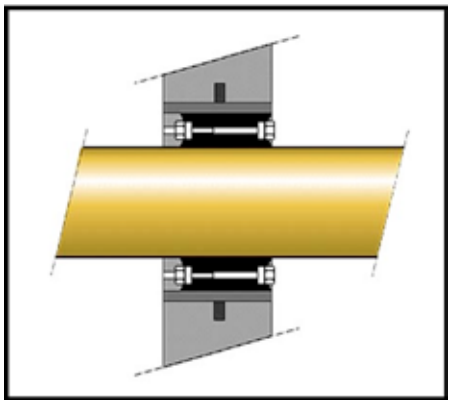


Figure 5-1

The puddle flange which is already laminated to the pipe body in the factory, consists of a ring. This puddle flange is placed into a recess in the wall, after which it is fixed with concrete or mortar.



6. PIPE CONNECTIONS THROUGH (CONCRETE) WALLS.

6.2 Link Seal

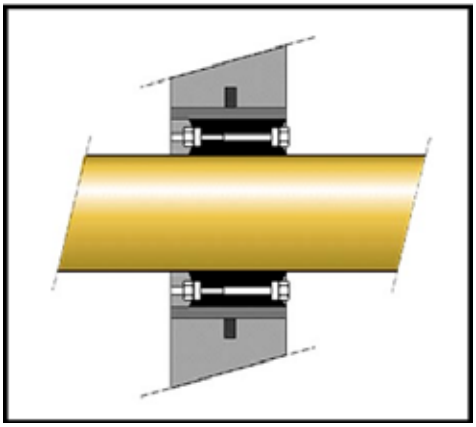


Figure 5-2

Link-Seals consist of several linked rubber parts shaped to fit the circular space between the GRP pipe and the inside of an insert in the wall. The rubber parts are interconnected by steel bolts, to form a rubber chain. Under each bolt head and nut, pressure rings are placed. After assembly of the Fiberglass pipe with the rubber "chain" into the circular wall insert, the rubber is compressed by tightening of the bolts, thus ensuring a complete watertight construction. Link-Seals are available in various materials. The rubber elements are made of EPDM, silicone or nitrile rubber.

Bolts are of stainless steel, or zinc or cadmium plated or phosphorated steel. The pressure rings are made of acetal polymer. As an additional advantage constructions with Link-Seals allow the GRP pipe a certain angular deflection and movement in an eccentric direction.

A sufficiently smooth surface of the hole inside the concrete wall can be obtained in various ways:

a. By fixing a steel pipe piece with water seal before pouring mortar.
b. By drilling a hole in the wall with a crown drill with diamond inlays.
c. By fixing a removable plastic casing pipe piece before pouring mortar. After removal of the casing pipe piece, the quality of the whole surface has to be checked.

6. PIPE CONNECTIONS THROUGH (CONCRETE) WALLS.

6.3 Casting and sandcoated Fiberglass pipe into the concrete wall

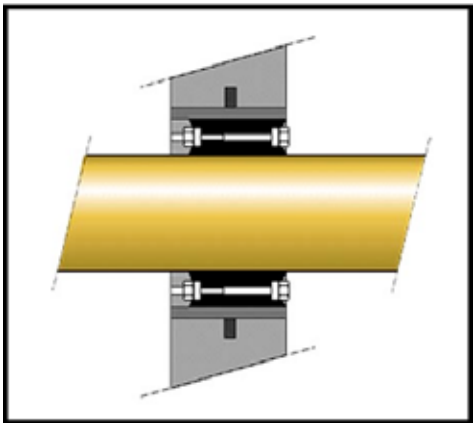


Figure 5-3

Sandcoating of Fiberglass pipe must be carried out as follows:-
Sand the pipe at the spot where it fits in the wall, over a length at least equal to the wall thickness. Apply a mixture of resin and hardener equal to that used for bonding or laminating Tamdid Pipes products with the aid of a brush, a roller or a spatula to the sanded surface. Pour sharp sand over the prepared surface and allow the resin mixture to cure.

Through this sandcoating an excellent adherence between concrete and Fiberglass is obtained.

6.4 Rolling Ring

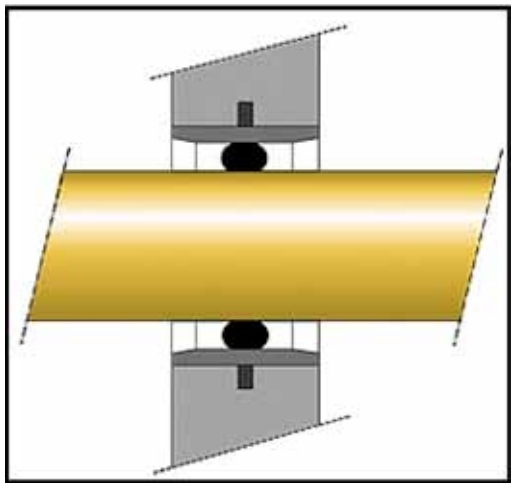


Figure 5-4

Using the rolling ring construction pipes going onto the wall should be provided with a guide-way in order to allow the ring to roll between pipe and wallcasting. The diameter of the guide-way should be a minimum of the outer diameter of the pipe + 2x diameter of the O-ring.

6. PIPE CONNECTIONS THROUGH (CONCRETE) WALLS.

6.5 special shaped sealing

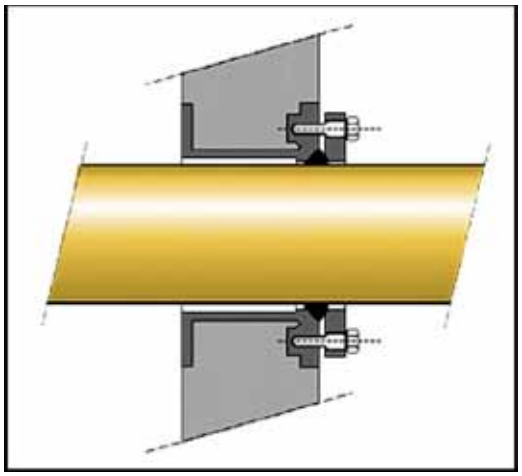


Figure 5-5

The wall penetration consists of a steel pipe provided with flanges. One of these flanges is profiled to fit the shape of the sealing element. By tightening the nuts the seal will be pressed in the wedge-shaped space between flange and pipe, thus creating an excellent seal.

6.6 No connection of the Fiberglass pipe to the (concrete) wall

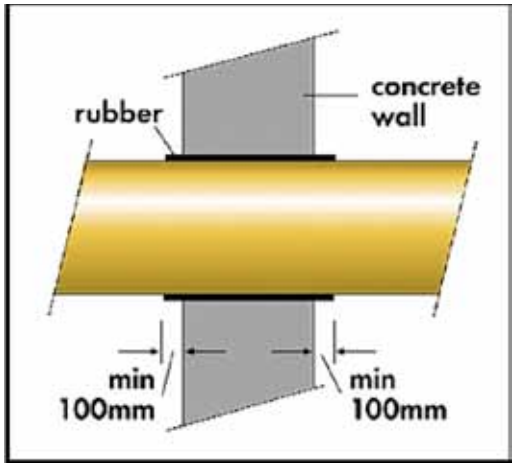


Figure 5-6

When a pipe has to pass through a wall, the outside of the pipe must be protected by a flexible material (a rubber layer, with a minimum thickness of 5mm with neoprene rubber or equivalent of 50 shore hardness) protruding some 100mm outside the wall at each side. In order to allow for setting of the adjoining pipe sections, flexible couplings must be installed on both sides of the wall. Joints must not be located at a distance of more than 1 x ID outside the wall, with a maximum of 0.5m.

7. GENERAL SAFETY RECOMMENDATIONS

- A fabrication area is to be setup to perform as much of the fabrication work as is practical or possible.
- Local exhaust ventilation should be provided at areas of cutting and/or tapering to remove airborne dust and fibers. General dilution ventilation should be provided as necessary to keep airborne dust and fibers below the applicable exposure limits and guidelines.
- Work area should be kept clean, including floor or other horizontal surfaces. Rinsing with water or sweeping with brushes or brooms (using floor sweep) is recommended. Brushes should be used to remove residue from shaved surfaces.
- Always refer to the Material Safety Data Sheet (MSDS) prior to working with unfamiliar materials or if there are questions concerning the contents of the fiberglass pipe.
- Barrier crane may be applied to the skin in areas, which may be exposed to shavings prior to beginning work.
- Clean clothes should be worn each day. Do not wear clothing that has not been laundered to begin a work shift. More frequent changing may be required by conditions.
- Long sleeved shirts or work suits should be used.
- Gloves with elastic cuffs should be worn at all times. Replace worn or contaminated gloves as necessary. Gloves with flared, stiff cuffs act as a gathering funnel for shavings.
- Pant legs should be worn outside work boots. If necessary for safety purposes, the pant legs can be taped to fit closely to the boot. Over-the-calf socks can be used to prevent chafing of the boot on the skin.
- Wristbands and watches should be removed to prevent rubbing or accumulation of particles on skin underneath the band.
- A respirator should be used if ventilation is unavailable, or is inadequate for keeping dust and fiber levels below the applicable exposure limits.
- Special Consideration for Repair/Maintenance of Contaminated Equipment: Use personal protective equipment as discussed above. Where possible, vacuum equipment before repair/maintenance to remove excessive dust and loose fibers.

7. GENERAL SAFETY RECOMMENDATIONS

7.1 Personal Hygiene

- Wash exposed skin with soap solution (liquid soap preferred) and cool water.
- Use washcloth with "brushing" motion to remove dust or fibers. Do not scrub the skin. This could result in the fibers being imbedded into the skin.
- Rinse thoroughly with clean, cold water.
- Apply lotion or cream to skin (non-detergent formulas such as baby lotion) to soothe irritation or prevent further immediate irritation.

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7.2 Health Safety & Environment Condition

7.2.1 General

The Contractor shall at his own expense arrange for all the safety provisions normally called for by the nature of the contracted Work and as ordered by the Company Representative, in respect of all labor directly or indirectly employed for performance of the Work. In case Contractor fails to make arrangements and provide necessary facilities as aforesaid, the company representative shall be entitled to do so and recover the cost thereof from the Contractor.

The Contractor shall be responsible for the safety of the equipment/material and Work to be performed by him and shall maintain all lighting, fencing, guards, signs etc., necessary for the performance. Contractor shall also take such additional precautions as may be indicated from time to time by the Company Representative with a view to prevent pilferage's accidents, fire hazards etc., Before the start of any work the Contractor, keeping in mind the continuous working of the existing plant, shall obtain suitable hot & cold working permits from the Company Representative.

7. GENERAL SAFETY RECOMMENDATIONS

7.2.2 Scaffolding

Suitable scaffolding shall be provided for workmen for all Work that cannot safely be done from the ground or from solid construction except for such short period work as can be done safely from ladders. Only pipe scaffolding is allowed for all the construction Work. When a ladder is used a helper shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds shall be provided on the ladder. The ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical)

Working platform, scaffolding or staging more than 4 meters above the ground level or floor level shall be closely boarded, shall be of adequate width and shall have a guard rail properly attached, bolted, braced and otherwise provided at-least 1 meter high above the floor or platform of such scaffolding or staging and extending along the entire length and the sides with only such openings as may be necessary for the entry of workmen and for delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure. Minimum thickness of planks used shall be 50 mm.

Every opening in the floor of a building or in a working platform shall be provided with suitable fencing or railing whose minimum height shall be 1 meter to prevent the fall of persons or materials.

Safe-means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length while the width between the side rails in rung ladder shall in no case be less than 30cms for ladder up to and including 3 meters in length. For longer ladder this width should be increased at least by 5 mm for each additional 300 mm of length. Spacing of steps shall be uniform and not exceeding 30cms.

8. FIELD HYDRO TESTING OF ABOVEGROUND PIPES

8.1 Filling, stabilizing and testing

Fill with water at the lowest point in the line using a small diameter branch connection and vent the trapped air at the highest point(s). Long straight sections may be vented using an inflatable ball or foam pig to expel any air and impurities.

After filling, the line must be pressurized gradually at 0.8 times working pressure dependent on the system and must be maintained for 24 hours allowing the pipe system to set. After the system is stabilized, the pressure must be raised gradually to the agreed field test pressure.

It is preferable to test the line in sections, for example the length of one day installation, which will be shut off by a temporary flanged joint and a ball. The blind flange should be provided with an air release valve. After testing the section, the ball needs to be pushed back about 2 meters using air via the air release valve. The excess water needs to be released by opening the valve at the start of the line. After the ball has been secured by inflating it, the temporary flange connection can be removed and assembly can continue. The advantage of this method is that the line does not need to be re-filled every time. Any leak which occurs caused by wrong assembly of the joints can be easily detected. Depressurization of the system must be done carefully to avoid negative pressures.

Bear in mind that temperature changes during day and night will affect the pressure in a closed system. A drop in pressure during the night does not indicate a leak. When testing a system the ambient temperature should be measured.

The low weight, the flexibility and elasticity of Fiberglass Pipe create different conditions compared with steel. If during testing a joint should fail, the system will whip, due to the sudden release of pressure and stored energy.

There is also a risk of injury to personnel. Testing with air or gas is extremely dangerous and should be avoided. Systems must never be tested with flammable fluids or gases! Extra co does not take any responsibility for any damage resulting from the use of these methods.

8. FIELD HYDRO TESTING OF ABOVEGROUND PIPES

8.2. Causes for pressure drop

The following causes may affect pressure and can be used as a check list.

a. Temperature change, by day as well as by night
b. Leakage of valves, fittings, hydrants, etc.
c. Leakage of gaskets
d. Dirt at sealing ring
e. Wrong installation of O-ring (slip ring)
f. Pipes or fittings insufficiently blocked in the trench resulting in displacement
g. Air lock
h. Leaking test equipment
i. Stabilizing time too short (24 h)
j. Leaking joint (adhesive bonded, rubber seal or laminated joint)
k. Leakage in fittings
l. Leakage of the pipe as result of damage (cracks)
m. Settlement of the pipe system.

Important notice

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